Evaluation of fibers in limbic circuits by tract-specific diffusion tensor analysis. -Accessing severity of Alzheimer disease.

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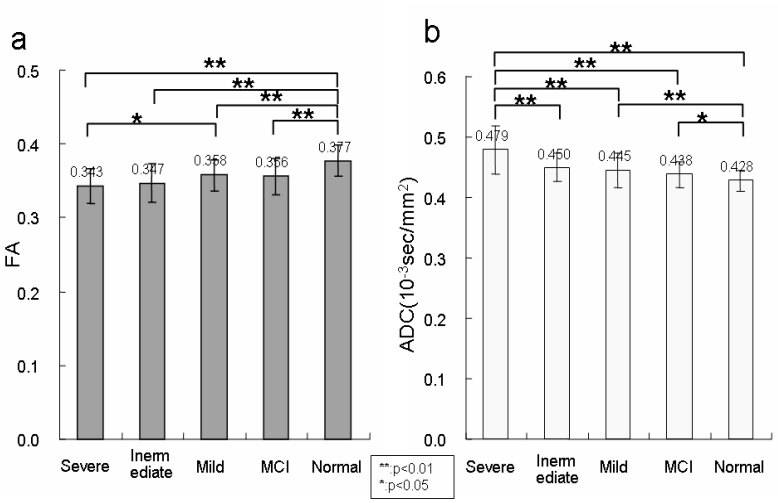
Purpose: The purpose of this study is to evaluate changes in fibers of limbic circuit using tract-based diffusion tensor analysis as an indicator of severity of Alzheimer disease (AD) and mild cognitive impairment (MCI) cases. We evaluated fractional anisotropy (FA) and apparent diffusion coefficient (ADC) along tracts included in limbic circuit.

Materials and Methods: The subjects were 107 AD cases including 27 MCI cases. Age matched 30 control subjects were also evaluated. AD cases included 12 severe (MMSE: less than 11), 33 intermediate (MMSE: 11-19) and 35 mild cases (MMSE: 20-22). Diffusion tensor images were acquired using EPI sequence. We acquired tractographies of uncinate fasciculus, anterior cingulum and posterior cingulum using diffusion tensor analysis software. We measured FA and ADC along the three tracts and compared the values between AD cases, MCI cases and control subjects, and evaluated statistical difference by ANOVA.



Results: Mean FA values along uncinate fasciculus of severe AD/ intermediate AD/ mild AD/ MCI/ normal subjects were 0.34/0.35/0.36 /0.36/0.38 which shows statistically significant difference ($p<0.01$) by ANOVA (Figure, a). While, mean FA of anterior cingulum were 0.36/0.40/ 0.42/0.42/0.42, and that of posterior cingulum were 0.38/0.40 /0.41/0.42/0.42 respectively. Both of them showed statistically significant differences ($p<0.01$).

Mean ADC($x10^{-3}$ sec/mm^2) values along uncinate fasciculus were 0.48/0.45/0.45/0.44/0.43, which showed statistically significant difference ($p<0.01$) (Figure, b). While, mean ADC of anterior cingulum were 0.45/0.42/0.42/0.41/0.40, and that of posterior cingulum were 0.45/0.43/0.42/ 0.41/0.40 respectively. Both of them showed statistically significant differences ($p<0.01$).

Conclusion: Increased diffusivity and decreased diffusion anisotropy in limbic circuits correlated to the severity of AD and MCI. Degeneration of white matter fiber tracts secondary to neuronal loss in the associative cortex may be one of the reasons of these AD associated changes in limbic circuits. Decreased FA and increased ADC may be useful as a marker for severity of AD.